Grade 8

PROCESS STANDARDS FOR MATHEMATICS

The Process Standards demonstrate the ways in which students should develop conceptual understanding of mathematical content, and the ways in which students should synthesize and apply mathematical skills.

PROCESS STANDARDS FOR MATHEMATICS	
PS.1: Make sense of problems and persevere in solving them.	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway, rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” and "Is my answer reasonable?" They understand the approaches of others to solving complex problems and identify correspondences between different approaches. Mathematically proficient students understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
PS.2: Reason abstractly and quantitatively.	Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.
PS.3: Construct viable arguments and critique the reasoning of others.	Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They analyze situations by breaking them into cases and recognize and use counterexamples. They organize their mathematical thinking, justify their conclusions and communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. They justify whether a given statement is true always, sometimes, or never. Mathematically proficient students participate and collaborate in a mathematics community. They listen to or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

PROCESS STANDARDS FOR MATHEMATICS	
PS.4: Model with mathematics.	Mathematically proficient students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace using a variety of appropriate strategies. They create and use a variety of representations to solve problems and to organize and communicate mathematical ideas. Mathematically proficient students apply what they know and are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
PS.5: Use appropriate tools strategically.	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Mathematically proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. Mathematically proficient students identify relevant external mathematical resources, such as digital content, and use them to pose or solve problems. They use technological tools to explore and deepen their understanding of concepts and to support the development of learning mathematics. They use technology to contribute to concept development, simulation, representation, reasoning, communication and problem solving.
PS.6: Attend to precision.	Mathematically proficient students communicate precisely to others. They use clear definitions, including correct mathematical language, in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They express solutions clearly and logically by using the appropriate mathematical terms and notation. They specify units of measure and label axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently and check the validity of their results in the context of the problem. They express numerical answers with a degree of precision appropriate for the problem context.
PS.7: Look for and make use of structure.	Mathematically proficient students look closely to discern a pattern or structure. They step back for an overview and shift perspective. They recognize and use properties of operations and equality. They organize and classify geometric shapes based on their attributes. They see expressions, equations, and geometric figures as single objects or as being composed of several objects.
PS.8: Look for and express regularity in repeated reasoning.	Mathematically proficient students notice if calculations are repeated and look for general methods and shortcuts. They notice regularity in mathematical problems and their work to create a rule or formula. Mathematically proficient students maintain oversight of the process, while attending to the details as they solve a problem. They continually evaluate the reasonableness of their intermediate results.

MATHEMATICS: GRADE 8

The Mathematics standards for grade 8 are supplemented by the Process Standards for Mathematics.

The Mathematics standards for grade 8 are made up of five strands: Number Sense; Computation; Algebra and Functions; Geometry and Measurement; and Data Analysis, Statistics, and Probability. The skills listed in each strand indicate what students in grade 8 should know and be able to do in Mathematics.

NUMBER SENSE

Indiana Academic Standards	Content Connectors
MA.8.NS.1: Give examples of rational and irrational numbers and explain the difference between them. Understand that every number has a decimal expansion; for rational numbers, show that the decimal expansion terminates or repeats, and convert a decimal expansion that repeats into a rational number.	**MA.8.NS.1.a.1**: Identify rational and irrational numbers.
	MA.8.NS.1.a.2: Round real numbers to the hundredths place.
MA.8.NS.2: Use rational approximations of irrational numbers to compare the size of irrational numbers, plot them approximately on a number line, and estimate the value of expressions involving irrational numbers.	**MA.8.NS.2.a.1**: Use the estimate of irrational numbers to locate them on a number line.
MA.8.NS.3: Given a numeric expression with common rational number bases and integer exponents, apply the properties of exponents to generate equivalent expressions.	**MA.8.NS.3.a.1**: Use properties of integer exponents to produce equivalent expressions.
MA.8.NS.4: Use square root symbols to represent solutions to equations of the form x^2 = p, where p is a positive rational number.	**MA.8.NS.4.a.1**: Solve equations using properties of square roots.

COMPUTATION

Indiana Academic Standards	Content Connectors
MA.8.C.1: Solve real-world problems with rational numbers by using multiple operations.	**MA.8.C.1.a.1**: Solve real-world problems with rational numbers by using two operations.
MA.8.C.2: Solve real-world and other mathematical problems involving numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Interpret scientific notation that has been generated by technology, such as a scientific calculator, graphing calculator, or excel spreadsheet.	**MA.8.C.2.a.1**: Perform operations with numbers expressed in scientific notation.

ALGEBRA AND FUNCTIONS

Indiana Academic Standards	Content Connectors
MA.8.AF.1: Solve linear equations with rational number coefficients fluently, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. Represent real-world problems using linear equations and inequalities in one variable and solve such problems.	**MA.8.AF.1.a.1**: Solve linear equations with two steps based on real world problems.
MA.8.AF.2: Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by transforming a given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).	**MA.8.AF.2.a.1**: Recognize when a linear equation has one solution, infinitely many solutions, or no solutions.
MA.8.AF.3: Understand that a function assigns to each x-value (independent variable) exactly one y-value (dependent variable), and that the graph of a function is the set of ordered pairs (x, y).	**MA.8.AF.3.a.1**: Distinguish between functions and non-functions in graphs or tables.
MA.8.AF.4: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear, has a maximum or minimum value). Sketch a graph that exhibits the qualitative features of a function that has been verbally described.	**MA.8.AF.4.a.1**: Given a graph, describe the defining features of a function. **MA.8.AF.4.a.2**: Given a verbal situation, identify its corresponding graph. **MA.8.AF.4.a.3**: Given a line graph of a situation, describe or select its qualitative features.
MA.8.AF.5: Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. Describe similarities and differences between linear and nonlinear functions from tables, graphs, verbal descriptions, and equations.	**MA.8.AF.5.a.1**: Given multiple representations, describe a function as linear and not linear.
MA.8.AF.6: Construct a function to model a linear relationship between two quantities given a verbal description, table of values, or graph. Recognize in y = mx + b that m is the slope (rate of change) and b is the y-intercept of the graph, and describe the meaning of each in the context of a problem.	**MA.8.AF.6.a.1**: Identify the rate of change (slope) and initial value (y-intercept) from graphs.

Indiana Academic Standards	Content Connectors
MA.8.AF.7: Compare properties of two linear functions given in different forms, such as a table of values, equation, verbal description, and graph (e.g., compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed).	**MA.8.AF.7.a.1**: Given a table or a graph, compare two linear functions to answer a question about rates.
MA.8.AF.8: Understand that solutions to a system of two linear equations correspond to points of intersection of their graphs because points of intersection satisfy both equations simultaneously. Approximate the solution of a system of equations by graphing and interpreting the reasonableness of the approximation.	**MA.8.AF.8.a.1**: Given a graph, identify the solution to a system of linear equations.

GEOMETRY AND MEASUREMENT

Indiana Academic Standards	Content Connectors
MA.8.GM.1: Identify, define and describe attributes of three-dimensional geometric objects (right rectangular prisms, cylinders, cones, spheres, and pyramids). Explore the effects of slicing these objects using appropriate technology and describe the two-dimensional figure that results.	**MA.8.GM.1.a.1**: Identify and describe attributes of three-dimensional geometric objects.
MA.8.GM.2: Solve real-world and other mathematical problems involving volume of cones, spheres, and pyramids and surface area of spheres.	**MA.8.GM.2.a.1**: Apply the formula to find the volume of three-dimensional shapes (e.g., cubes, spheres, and cylinders).
MA.8.GM.3: Verify experimentally the properties of rotations, reflections, and translations, including: lines are mapped to lines, and line segments to line segments of the same length; angles are mapped to angles of the same measure; and parallel lines are mapped to parallel lines.	**MA.8.GM.3.a.1**: Recognize a rotation, reflection, or translation of a figure.
MA.8.GM.4: Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations. Describe a sequence that exhibits the congruence between two given congruent figures.	**MA.8.GM.4.a.1**: Describe a sequence of transformations between two congruent figures.
MA.8.GM.5: Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations,	**MA.8.GM.5.a.1**: Describe a sequence of transformations between two similar figures.

Indiana Academic Standards	Content Connectors
reflections, translations, and dilations. Describe a sequence that exhibits the similarity between two given similar figures.	
MA.8.GM.6: Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.	**MA.8.GM.6.a.1**: Describe the effects of transformations on the coordinates of a figure.
MA.8.GM.7: Use inductive reasoning to explain the Pythagorean relationship.	**MA.8.GM.7.a.1**: Given the lengths of the sides of a right triangle, determine which one must be the hypotenuse.
MA.8.GM.8: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and other mathematical problems in two dimensions.	**MA.8.GM.8.a.1**: Apply the Pythagorean Theorem to determine lengths/distances in real-world situations.
	MA.8.GM.8.a.2: Find the hypotenuse of a right triangle using the Pythagorean Theorem.
MA.8.GM.9: Apply the Pythagorean Theorem to find the distance between two points in a coordinate plane.	**MA.8.GM.9.a.1**: Apply the Pythagorean Theorem to determine lengths/distances on a coordinate plane.

DATA ANALYSIS, STATISTICS AND PROBABILITY

Indiana Academic Standards	Content Connectors
MA.8.DSP.1: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantitative variables. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.	**MA.8.DSP.1.a.1**: Graph bivariate data using scatter plots and identify possible associations between the variables.
	MA.8.DSP.1.a.2: Using scatter plots, identify data points that appear to be outliers.
MA.8.DSP.2: Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and describe the model fit by judging the closeness of the data points to the line.	**MA.8.DSP.2.a.1**: Identify a linear association when analyzing bivariate data on a scatter plot.
MA.8.DSP.3: Write and use equations that model linear relationships to make predictions, including interpolation and extrapolation, in real-world situations involving bivariate measurement data; interpret the slope and y-intercept.	**MA.8.DSP.3.a.1**: Use the line of best fit to find a point that answers a question about the data.
MA.8.DSP.4: Understand that, just as with simple events, the probability of a compound event is the	**MA.8.DSP.4.a.1**: Determine the probability of simple events.

Indiana Academic Standards	Content Connectors
fraction of outcomes in the sample space for which the compound event occurs. Understand and use appropriate terminology to describe independent, dependent, complementary, and mutually exclusive events.	
MA.8.DSP.5: Represent sample spaces and find probabilities of compound events (independent and dependent) using methods, such as organized lists, tables, and tree diagrams.	**MA.8.DSP.5.a.1**: Determine the theoretical probability of multi-stage probability experiments (2 coins, 2 dice).
MA.8.DSP.6: For events with a large number of outcomes, understand the use of the multiplication counting principle. Develop the multiplication counting principle and apply it to situations with a large number of outcomes.	**MA.8.DSP.6.a.1**: Use the multiplication counting principle to determine the total number of outcomes.